IDENTIFICATION OF SUITABLE RHIZOBACTERIAL SPECIES AGAINST FLUORIDE TOXICITY

A
Pre-Synopsis
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INTRODUCTION

Pollution is the introduction of the harmful chemicals or contaminants to the environment which causes harmful effects on the existing living as well as on non-living things. The pollution is mainly classified as Air, Water, Land, Noise, Thermal and Radioactive Pollution. Each type affects in one and other way.

As India is a developing country, among various other problems, environmental pollution is of high alert. It is affecting both plants as well as animals. As the population of our country is 2nd largest in the world so to feed billion of mouths we need much more resources which may be by the agriculture or the industrialization and ultimately the productivity must be increased. Thus we are hell-bent to use various chemicals like pesticides and insecticides. As the use of these chemicals increased they accumulated in the environment, leading to the particular type of environmental pollution.

These Pollutants are already present in earth crust by the excessive use of naturally occurring ground water source these minerals comes to the upper layers and causes pollution. Fluoride is present in soil as specifically and non-specifically adsorbed ions and compounds (Bowen 1966; Robinson 1978; Pickering 1985). As plants, animals and humans consume this ground water resource which ultimately causes negative effect on their growth and natural processes.

There are many sources of ground water pollution which may be salinity, Fluoride, sulphide, Iron, Arsenic, Manganese, Nitrate, chloride and Heavy metals. The Central Pollution Control Board undertook a major ground water quality survey and the report published in 1995 identified about 20 locations in various states of India as critical sites of ground water pollution. This is natural that salts and mineral concentration are different at different locations but human activities have extended the areas affected by this. Factories producing fertilizer, aluminium, steel, bricks, glass as well as coal fired power stations produce Fluoride rich emissions that can seriously affect surrounding plants and animals. Fluoride also comes to the atmosphere by the F rich volcanic ash (Oskarsson 1980).We cannot change natural abundance of salts and minerals at various places, we cannot stop industrialization, we also cannot change the greedy nature of the humans of thinking their own benefits without taking care of the rest.

So, on the basis of present scenario we have to take some steps or develop some strategies to overcome the above discussed negative effect on the environment. The fluoride is present as toxicant in many states of our country like Andhra Pradesh, Bihar, Gujrat, Karnatka, Haryana, Kerala, Madhya Pradesh ,Maharashtra, Orissa, Punjab, Rajasthan, U.P., Tamilnadu, and West Bengal because it is present in more than required amount.

Fluoride comes to the atmosphere in both gaseous and solid particulate forms and causing air as well as soil pollution. The gaseous forms are like hydrogen fluoride and sodium tetrafluoride are the most common air pollutants. The gases are absorbed and particulate matter falls on the vegetation which further causes various harmful effects to their growth and in various other activities. When animals and humans take such type of fluoride treated vegetation it accumulate in their body and incorporate in their bones and tooth mineral. A lot of work has been done on effect of fluoride on Plant and Animals.

The anthropogenic activities which may be as industrial effluent or the improper use of the natural resources cause alteration in the biogeochemical cycles. Thus, pollutants start accumulating in the environment and responsible for environmental pollution. Pollutants may be certain ions, salts, complex compounds or heavy metals. As soil microorganisms are responsible for the cycling of various gases, minerals and salts in ecosystem, they play a vital role in maintaining the critical balance in the environment. Various pollutants also affect their activities and disturb the ecological cycles.

Review of Literature

As in my research work the core part of discussion is the effect of fluoride toxicity on rhizobacterial activities. These rhizobacteria are the type of bacteria which are present in the rhizospheric region. This rhizosphere is the narrow region of soil around the root of a plant body which is directly influenced by the roots secretions and associated soil microorganisms called as Rhizobacteria. These rhizobacteria may be extracellular that is present in the rhizosphere and intracellular or endophytic which form root nodules in the apoplastic region of plant body (Vessey, 2003)

On the basis of functions about 2-5% of these rhizobacteria are Plant Growth Promoting rhizobacteria (PGPR) (Kloepper and Schroth, 1978) like Azospirillum, Pseudomonas, Rhizobium and Allorhizobium etc. These PGPR promote the growth of plant body by many ways like Nitrogen fixation (Verma et al., 1986), production of IAA growth hormone (Martens and Frankenberger, 1991; Frankenberger and Arshad, 1995). , Phosphate solubilisation (Goldstein, 1986; Rodriguez and Fraga, 1999), siderophore production (Thomashow and Weller, 1988) and reduction of ethylene level by the enzyme ACC deaminase (Glick, 1995) etc. Some give harmful effects are called as Deleterious Rhizobacteria (DRB) like Klebsiella, Flavobacterium, Achromobacter, Arthrobacter etc. These deleterious rhizobacteria may reduce the germination rate, cause root lesions, compete for nutrients, may also increase fungal infection and reduced growth of Plant body (Nehl et al., 1996; Sturz and Christie, 2003). Some rhizobacteria have no effect on the growth of plant so they are called as Neutral Rhizobacteria (NB).

The Plant growth Promoting rhizobacterial species plays very beneficial role for the plant body in whose rhizosphere they are present. Plants release wide range of exudates in the Rhizosphere and these results in highly active and diverse microbial population. As a result bacterial density increases from 10 to 200 times (Neumann G. & Romheld V. 2000). These exudates mainly consist of sugars and organic acids. These PGPR protect host plant from acute biotoxicity and make phytoextraction more effective. So these rhizobacteria are much important in replacing the status of a nation from the begging bowl to the bowl full of rice.

Fluorine is widely dispersed in nature and is estimated to be the 13th most abundant element on our planet (Mason and Moore, 1982). In most developed and developing countries native soil Fluoride contents are strongly affected by application of fertilizers and by deposition of industrial air-borne pollutants. Labile and water soluble F concentrations appear to be affected most by industrial pollution (Polomski et al., 1982; Haidouti, 1991) and superphosphate application (Larsen and Widdowson 1971; Manoharan et al., 1996; Robinson and Edgington, 1946). However, prolonged application of superphosphate can have marked effects on total soil Fluoride (Kudzin and Pashova, 1970). Also, the extraction of deep Fluoride rich ground waters to maintain production during droughts and summer periods has caused numerous cases of

fluorosis (Botha et al., 1993). It will take no longer time to affect our crops, grazing animals, water supplies, and soil organisms.

Fluoride toxicity in plants is normally indicated by necrosis which begins on the margins or tips of the leaves and moves inward (Thomas, 1951). Both of these conditions lead to decreased photosynthetic efficiency and lower plant yields (Brewer et al. 1967; Robinson, 1978). Other effects include reduction in flower production and flower quality (Koster, 1972). Many studies have revealed that adjacent to industrial areas and active volcanoes airborne contaminants are the most important source of excess Fluoride in plants (Thomas, 1951; Adams, 1956; Treshaw, 1971; Istas and Alaerts, 1974; Gritsan et al., 1995). Fluoride is absorbed by the plant leaves and roots (Brewer, 1966). Irrigation water can also be an important source of Fluoride. (Singh et.al,1995). Some studies have suggested that Fluoride complex ions, such as Aluminium-Fluoride complexes (Takmaz-Nisancioglu and Davison, 1988; MacLean et al., 1992) and Silicon-Boron-Fluoride complexes (Collet, 1969) are taken up by plants to a greater degree than free fluoride. The low pH may increase fluoride uptake by plants.

Fluoride given as Aluminium fluoride (AlF_3) in solution culture show more uptake than Sodium fluoride (NaF) (Takmaz-Nisancioglu and Davison, 1988). Excess fluoride also causes the leaching of organic matter, iron and Phosphorus in acidic soils (Wilke, 1987). In acidic soils, a significant fraction of fluoride exists as AlF^{2+} and AlF_2^{+} (Manoharanet et al., 1996). Although recent studies indicated that Aluminium-Fluoride complexes are non-toxic to plants at lower concentrations but toxic at higher concentrations. It also varies from species to species (Manoharan, 1997; McLaughlin et al., 1997). The increased fluoride also inhibits the activities of many soil microorganisms (Rao and Pal, 1978).

So there is an urgent need to study impacts of elevated F levels on soil microorganisms and on their beneficial activities.

AIM & OBJECTIVES

The aim of this study is, Identification of suitable rhizobacterial species against Fluoride toxicity.

The systematic approach of the research work will be as follows:

- ✓ Collection of different rhizobacterial species.
- ✓ Comparative Growth-kinetics study.
- ✓ Estimation of fluoride absorption from media to bacterial cell.
- ✓ To check the effect of acidic and basic pH on fluoride absorption.
- ✓ Comparison of PGPR activities in presence of Fluoride.
- ✓ Statistical analysis and to make the best screened species and try to make them resistant against higher fluoride concentration.

MATERIAL & METHOD

1) Collection of Rhizobacterial strains

First and foremost we collect rhizospheric soil as well as nodule samples of chick pea plant from different fluoride affected areas. We also collect various rhizobacterial strains from IMTECH Chandigarh.

2) Comparative growth kinetics study

To check the effect of fluoride on selected rhizobacterial species firstly we decide the Minimum Inhibitory Concentration (MIC) for rhizobacterial strains to grow and then will try to check the effect of fluoride on the growth kinetics of all selected rhizobacterial strains at specific time intervals in the presence as well as in the absence of fluoride.

3) Estimation of fluoride absorption from media to bacterial cell

Estimation of fluoride will be done with the help of potentiometric ion selective electrode (ISE) method for both media as well as bacterial pellet. Colorimetric methods are available, but are more time consuming and less sensitive (Kakabadse et al., 1971).

4) To check the effect of acidic and basic pH on fluoride absorption

The toxicity of fluoride is a pH dependent mechanism. This is due to the existence of different ionic (F^-) and non-ionic (HF) forms of fluoride at different pH values. So we will try to check its toxic effects at acidic as well as basic pH conditions and compare them with respect to the neutral pH.

5) Comparison of PGPR activities in presence of Fluoride

PGPR activity	Reference
IAA Production	Gordon and Weber, 1951
Siderophore Production	Schwyn and Neilands, 1987
Nitrogen fixation	Standard method, 1997

6) Statistical analysis and to make the best screened species and try to make them resistant against higher fluoride concentration.

Data analysis will be performed to find the best rhizobacterial species for fluoride affected areas among the screened strains and try to make them resistant at higher fluoride concentration.

SIGNIFICANCE

Fluoride has its worldwide distribution out of which India and China are worst affected. So on the basis of present scenario there is urgent need to find some beneficial bacterial species which could give better yield in these circumstances.

FUTURE PROSPECTS

If we introduce such rhizobacterial strain to the fields then definitely the productivity will increase in the affected areas which will be beneficial for both farmers and economy of the country. Further, molecular studies can help to improve various PGPR activities in the presence of fluoride toxicant.

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